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[Despatch Abstract.]

Public services - Provincial - Madras Agricultural Service - Temporary posts of Cytogeneticist and Plant Physiologists, Bapatla - Review of work.

Report of the work done so far by the two Cytogeneticist at Bapatla and Coimbatore.

BAPATLA.

Dr. N. Krishnaswamy, assumed charge of the post of the Cytogeneticist on the 28th August and continued there, upto 18th August 1947. During this period under report, most of his time was spent in equipping the laboratory and teaching the second year class in Systematic and Crop Botany, in addition to teaching his regular portion in Plant Breeding and Genetics, till the Gazetted Assistant in Botany joined duty on 2nd February 1947. He commenced his work on Paddy and Cambu. Six will species of paddy were collected and grown in pots cultures. In addition, 19 strains of Maruter and 24 strains of Coimbatore were obtained and grew them for his study. The plant material of the trispecific cross of paddy obtained from the Paddy Specialist was obtained and cultured at Bapatla to ascertain the cause of its complete sterlity. It was found that the stigma emerged freely but the staments are malformed with abortive pollen grains. The panicles were periodically examined. The anther were noticed to be atrophied and the outer glunes alone matured. This work on paddy was continued by Sri. S. Sampath on his taking charge from August. The chromosome number of wild paddy varieties were determined. The small grained 2 0 officinates this deploid chromosome and that Oryza latifolia and Eichengeriwere of the tetraploid group. Oryza longistaminate has both deploid and tetraploid form. The one collected as belonging to O. Meyeriana, happended to have 48 chronosomes. Crosses were made between Mdu. 4. and the local wild paddy, found growing in ponds and water courses. During the crop period, he examined all the types grown in the College Farm, with a view to maintain them pure for his future work. He also studied the semi-sterile muthusamba progenies and tried to induce doubling of the chromosome to make it fertile by chemical treatment, but without success.

The study of the F.1 plants of the crosses made by Dr. Krishnaswamy between Pennistum typoides (Cambu) and P. Purpurenu (Elephant grass) consisted of different forms. The study of chromosome numbers in these plants were 21 indicating hybridity. These plants were more robust and vigorous and better tillering than normal cambu plant. But they did not set seeds. Attempts were therefore made to indue seed setting by Polyploidy or back crossing. Various methods tried did not result in the expected results. A cytological study of the Thin Napier Grass showed it to contain 56 chromosomes, double that of Elephant grass. The secondary roots however, contained less than 50 and showed variation among themselves This is an ~~an~~ unusual cytological feature worthy of further study. It is therefore considered that attempts to double the chromosome number in cambu may make it a more useful breeding material. Incidentally a study of the different varieties of sweet potate was made and a successful cross was effected between the varieties. A short note on the hybridisation of sweet potato varieties was written up by Mr. S. Sampath.

COIMBATORE.

S. Sampath assumed charge of the post at Coimbatore in July 1946 and was relieved on 22nd August 1947 to join his post at Bapatla. The work followed up by Dr. N. Krishnaswami is reported below.

To start with, some preliminary work was done, to gain experience on the use of the different chemicals and at different strength. The chemicals studied were colchicine, saponine, traces of thymol. The materials taken up for these studies were the inter-specific hybrid of Pennisetum typhoides (Cambu) and P. Purpureum (Elephant Grass) and Ryzomes of sterile paddy mutant. All of these did not survive the test. There was some effect on

the buds of young seedlings of Annona. The seedlings have been planted to test the effect of the treatments. Co 1 (Cambu) also failed to respond to the treatments. Next Acena-htene was tried on Co. 1 cambu. Cholam and paddy (GEB 24). It was effective on cambu alone. The material so treated have been carried forward for further trial.

Side by side the fixatives for the materials prepared for Cyto-genetic study were examined and the following chemicals were found satisfactory viz., uranium acetate, Pottasium Chromate and Formalition mixture. Chromosome numbers were after repeated examination determined in the following plants.

(i) Anona Squamosa. 2 N - 14.

(ii) Sesbania Speciosa. 2 N - 24.

(iii) Myctanths arbotristis - 2 N - C.50.

The effect of Acenaphtene was only temporary. The pre-treatment of seed in various oils has not been much of help in mitigating the harmful effect of the young germ emerging, while being treated with strong chemicals.

Dr. Krishnaswamy took charge of the work on the 22nd August and continued the work commenced by Sri. S. Sampath.

As Colchicine was not easily obtainable, he tried to make use of the extract of gloriosa superba roots which contain the same alkaloid principle though in a crude form. This crude drug did not induce any change in the trispecific hybrids of paddy. The test is being continued. The Biochemist at the Indian Institute of Science, Bangalore has been requested if he can help to isolate the alkoloid from the roots in a pure form. Further study of the sterile mutant in paddy to locate the particular set of chromosomes that are missing by doing comparative measurement of the chromosome is in progress.

In order to produce more hybrid forms to indue drought resistence in cambu, it was crossed with Kikyu grass, Dry Napier, and Kolakatai grasses. Attempts are being made to produce amphidiploidy in the sterile hybrid of cambu - X Elephant grass.

The method of heat shock on cambu at different temperatures and duration is also in progress. As this treatment has produced albinism in the first generation, it is hoped, it might also have produced some change in the normal seedlings. The effect of this treatment will be visible in the next generation. The treet seeds of cambu and cholam to indue polyploidy is being continued. The treated seeds have been sown.

Work on clusterbeans, field lablab was also taken and pods from treated plant were collected and await study of the progenies in the coming season. Methods to produce seedless fruits in Mango and citrus varieties have just been commenced. A detailed scheme for this special work has been sent to Indian Council of Agricultural Research for sanctioning necessary staff. Cytological study of mangostene showed it to contain chromosomes No. 2N-50.

Among the miscellaneous studies, the collection of jasmine species wild and cultivated is being done to take their study and domesticate the wild ones by suitable means. A short note dealing with the work done on this plant is being written up for publication by Dr. N. Krishnaswamy.

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H.Q. Deputy Director of
Agriculture.

Report of Plant Physiologist, Coimbatore.

I submit the report of the work done so far by the Pla Physiologist at Coimbatore.

He took charge of the post of Plant Physiologist, und the Government Agricultural Chemist on the fore-noon of March 20, 1946.

In pursuance of the decision of the Research Council, emphasis was laid in drawing up this programme on paddy and the following aspects of its culture was proposed for study in the first instance.

(a) Nutritional and physiological studies on the Rice Pla with special reference to the diagnosis on nutrient deficienci by visual symptoms.

(b) Vernalisation and allied methods of pre-treatment wi the object of shortening the life cycle without loss of yield and making it possible to raise paddy under normally unsuitabl conditions.

(c) Pretreatment with growth hormones for increasing yields.

Summary of work done is given below.

1. Early growth of paddy in relation to their duration and response to growth hormones:

A simple method was devised for carrying out growth-measurements on paddy seedlings over a period of four or five days for studying the difference in response of paddy varieties of short, medium and long durations when grown in water as well as various concentrations of indole-acetic acid.

Root growth:- Under normal conditions, was more rapid in short duration varieties than in medium or long duration types. With the addition of indole-acetic acid the root growth was found to be depressed by low concentrations upto 72 hours and stimulated thereafter. A concentration of 0.05 mgms. per litre showed the highest stimulation. Higher concentrations depressed the root growth. This response was common to all the three duration groups so far tested in paddy.

In the case of root number, the short and medium duration groups were similar and had normally a smaller number of roots than long duration varieties. Under the actior of indole-acetic acid, the average root number was increased in short duration types by 10 parts per million, and depressed by 50 p.m. Medium varieties showed a decrese in root number by low concentrations of 0.05 and 0.5 p.p.m. while in the long duration types, the root number was depressed by all concentrations higher than 0.05 p.p.m. of indole acetic acid.

Shoot growth:- Short duration varieties when grown in distilled water showed a higher rate of growth than medium or long-duration varieties. With indole-acetic acid the short group showed a very marked stimulation of growth at concentrations of 10,20, and 50 p.p.m. while the response in the other two groups was not very well defined or regular.

The method would seem to offer a possibility of judging the duration of varieties by testing their early

growth of root and shoot in various concentrations of growth-promoting substances.

Nutritional and Physiological experiments on paddy:-

1. Fertility studies in the Central Farm Wetlands:-

An investigation was started to see how far yield differences were predictable from soil analysis supplemented by the chemical composition and growth features of paddy plants sampled at different stages of growth. The results so far obtained indicate that there is good agreement between (1) the availabile nutrients in the top 6" of soil. (2) Plant characters like height and tillering, (3) the total out turn of grains plus straw per acre, and (4) the fertility level of each block as indicated by the average yield for the past 25 years.

Spraying with trace elements for improving paddy yields:

Based upon the work and results reported by Roach in England a preliminary trial was carried out on paddy using sprays of different trace elements salts, viz., copper, zinc and manganese. The grain yield from plots sprayed with all three salts was higher than control by nearly 24% but the increase was not satistically significant. The ratio of grain to straw was also somewhat higher but further work is needed before any definite conclusions can be drawn.

A series of field trials was made in the course of 1946-47 at the Pattambi and Mangalore Research Stations to see if copper sulphate in different dilutions could help in improving paddy yields as claimed by Castillo (1940) and Harrison and Ayyar ~~&~~ in 1917. The results showed that yields were not improved by spraying with copper sulphate solution.

Nutrition Experiment on paddy:- A pot culture study was made on the interelations between nitrogen and phosphorous on paddy growth, using four levels of nitrogen and three of phosphorous. Growth was improved by each dose of nitrogen from 0.40, 80 and 160 lbs. per acre units, but a single dose of 30 lb. per acre of P.2 05 was found to be only as good as zero level. A double dose of 60 lb. acre was necessary to show an appreciable increase in plant height. Flowering was hastened by 60 lb. of P.2. 05 but the nitrogen levels had no effect nor the single dose of phosphorous.

In the case of yield, however, a double dose of phosphorous did not seem to be superior to the single dose of 30 lb. of P. 205 per acre.

Experiments are also in progress to study the inter-relations of magnesium in the nutrition of paddy.

Prehardening experiments:- Paddy plants from seed soaked and dried before sowing showed a quicker growth and somewhat better yields than controls.

Vernalisation:- Nearly ~~&~~ fifty experiments were carried out to study the response of paddy varieties to various photoperiodic treatments. A wide range of varietal differences was observed, ranging from 14 days retardation of flowering of 24 days acceleration. Short-duration varieties appeared to be somewhat more responsive to vernalisation than medium and long duration types. In growth and yield too vernalised plants were better than controls, particularly in the case of certain

long duration strains like AKP. 5 and MTU. 7.

Effect of Boron on sweet potatoes:- A pronounced increase in tuber yields was observed as a result of adding 5-10 parts of boron to sweet potatoe plants. Higher doses depressed the yields and 100 parts of Boron per million was definitely toxic and inhibited tuber formation altogether. Field experiments are in progress to verify the effect of lower doses on the yield.

Experiments were also done to study the effect of nutrient deficiencies on sweet potatoes. Nitrogen and calcium deficiencies, were seen to result in a greater reduction of growth and yield than P K or S deficiencies.

Effect of copper on sweet potatoes:- In pot cultures, even such a high concentration of 200 parts per million of copper sulphate (equivalent to 56 lb. per acre) produced no toxic effect on growth, beyond a slight acceleration offlowing and a reduction in tuber, yields. A very slight and non-significant increase in shoot weight and tuber weights were observed with 5 p.p.m. of copper sulphate.

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H.Q. Deputy Director of
Agriculture.

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Report of work done in Plant Physiology from 13.6.1947. to 31.3.1948.

Charge:- I took charge on 13.6.1947 and the Assistant in Plant Physiology oined on 19.9.1947. From 15.1.1948 to 4.2.48, the post of Assistant in Plant Physiology remained vacant. The vacancy was filled up by Sri. M.V. Ramamurthy who worked as Assistant only for 27 days and subsequently from 1.3.1948. Mr. K. Divakaran posted as Assistant is continuing.

Equipment:- This is a new research wing added to the College from June 1947. Prompt steps have been taken to equip the Plant Physiology Laboratory. 250 glazed pots differential thermostat, electrolux refrigerator, electric incubator, heat regulator, etc. were got during the year. Two small cages were set up for carrying out pot culture experiments. The equipment is not yet complete and it will take some more time to complete it, as there is great dearth for many of the patent plant physiology apparatus and instruments.

Research work:-

(1) Paddy:- With the available equipment immediate work was taken up with paddy to study the drought resistance, salt tolerance and submersion resistance of a few important varieties and to explore methods to indue the same and thus seek further avenues of improvement from these physiological studies.

1. Salt Tolerance:- A few major paddy strains cultivated in this Province like GEB 24, ADT 21 were chosen to assess their tolerance to Sodium chloride, the commonest ingredient present in the coastal areas in concentration ranging from 0.05 to 0.25%. For comparative purposes two reputed salt toleran varieties, Tellathoka Vadlu and S.R. 26 B of Orissa were also chosen. The trial to test the tolerance of these varieties to sulphates and carbonates of Sodium was not taken up then, for want of glazed pots.

The results of experiments conducted in the last season

showed that S.R. 26-B could yield almost double that of GEB 24 under all the different concentrations taken as a whole. Beyond 0.15% concentration of salt there was a sudden decrease in yield in all the strains. As against the evidence recorded in literature that 0.25% is highest, toxic limit, at this concentration of Sodium chloride it was found that the plants could survive. There was surprisingly no maortality in any of the strains. Traces of Sodium chloride upto 0.05% does not seem to and affect the yield in fact a slight increase was recorded.

2. Submersion Resistance:- Water was kept at different levels of heights ranging from 6" to 2' for a fortnight in special cement tubs where paddy was transplanted and the response to submersion was studied on plants at different ages,viz., 15,30,45 and 60 days after transplantating.

PTB. 16 Kavinganpoothala of Malabar and MTU 16 Badava Kusuma of Circars were also used. In any period of life, if the level of water increases over 6", the yield seems to be affected in these varieties. The yield has not been as high even in 9" depth of water as in 6" depth. Beyond 6" the level of water is critical; as there was low yield and reduced tillering at further levels. The maintenance of 6" level of water in the first 15 to 30 days after transplanting of the crop showed correlation to the ultimate performance of the crop. None of the varieties withstood submersion 15 days after transplanting or even later if the water level exceeds 15".

Water Requirements:- To assess the water requirements of semi-dry, wet and dry paddy varieties, one strain in each was chosen and water added and lost in transpiration was recorded. During the later stages the paraffin caked up and separated from the mud pots and the results were vitiated. Hence the data was rejected. This will be repeated with water proof glazed pots which have now arrived.

4. Wet and Dry cultivation experiments:-The root extension of MTU 7 grown largely in this tract was periodically recorded from plots planted after puddling and with mere letting in water after dry ploughing.

An analysis of the data showed that the plants in the puddled plot established and grow quicker in the initial stages. Subsequently the growth evened up. The differences in yield at the time of harvest. In advanced stages the root extension could not be accurately recorded due to the old roots, stickly soil and the difficulty experienced in excavating the plant under wet conditions. As reliable data could not be gathered in the above, it is proposed to take up in pots only in the nursery stage to compare physiologically the merits of wet and dry nursery seedlings by their growth, respiration ratio, root extansion, etc.

5. Testing drought and wilt resistance:- As the apparatus which artifically controls humidity and temperature was quoted prohibitively high by firms abroad, the trial to test the wilt and drought resistance of paddy varieties was abandoned.

6. Pretreatment of paddy for drought and submersion resistance:- Attempts are being made by treating seeds of Geb. 24, MTY 12, Co 17 and ADT 22 to induce drought and submersion resistance by the following means:-

1. With methane, at low concentration.
2. With partial vacuum.
3. Heat and cold treatment alternately.
4. Continuous and alternate treatment between 0 to 10C.

This work has just started.

7. Studies on Hormones:- As per circular of the Director of Agriculture No. L.Dis. Y.I. 381/48 of 11.3.1948, studies to test and assess the effect of hormones on indigenous crops was taken up as a part of the regular programme of work.

Indents have been placed abroad for some hormones and some firms in South India have sent free samples for trial. It is proposed to standardise and assess the several growth promoting substances now sold in the market on indigenous crops under our conditions.

Hortomone A has already been tried with Lemons Glyricidia, Pineapples, Sesbania, etc. The concentration of three in thousand as prescribed by the Imperial Chemical Industries was found toxic and a far lower concentration viz., 1 in thousand seems to give moderate results in root initiation. The root production stimulated by this hormone is very slow and not of a striking nature. But it was found that the mortality in cuttings could be reduced by pretreatment with this hormone in some cases.

Several other hormones like Phyonone, P.P. Tomato set, Extar Sandoz have been received for trial from firms. The work has just been taken up.

6. Studies on root formation and callusing in Lemons:-

The study was taken up at the instance of the Director of Agriculture to find out the optimum temperature for rooting lemons.

Experiments during the last 3-4 months showed that the optimum temperature ranges between 70 to 80 F and temperatures above or below detrimental to callus formation. The callusing itself is a very slow process and takes about a month.

Irrespective of the season, if the above temperature could be maintained, it is possible toachieve success in propagation of lemons, as fundamentally this temperature reduces the transpiration loss and aids the slow callus formation and cell growth. The success is also dependent on other factors, viz., the thickness of the cutting, nature of soil, availability of moisture, but these are easily controllable factors.

9. Trials on inducing germination in hard coated seeds:-

Over 80% germination could be induced in Lucaena glauca by pre-treating the seeds before sowing by soaking in hot water for five minutes -- between 70 to 80 0 C.

Similar success has been achieved with other hard coated seeds like Delonix regia, Delonix eleta between 80 to 90 0 C.

In Zizyphus it was found that breaking the hard stone which acts a barrier, and sowing naked seeds after soaking in luke warm water, over 30% germination could be obtained as against 2 to 3 per cent obtained in untreated seeds.

Teaching:- Students of the final year B.Sc. (Agriculture) classes were engaged for 61 hours in theory and practical horticulture, during the year.

Publications RTC:- A note on vegetable furnishing brief information entitled "Vegetable details" was sent to the Mezhichelvam annual number 1948, for publication.

2. An article entitled 'Effect of cold and heat treatments on Lucaena glauca -- a method of improving germination" wassent for publication in the Madras Agricultural Journal.

3. A lecture was delivered to the Students' Club of the College on 'Crop and its environment'.

Only ten months have elapsed since the section was inaugurated. Definite conclusions cannot be reached on the results achieved so far at this stage, as the period is too short. The equipment of the laboratory is in progress and simultaneously some initial trials are underway. At least a period of three years is required to confirm the results and show tangible achievements in research work pertaining to Plant Physiology.

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For Principal, Agricultural
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RESEARCH PROGRAMME IN PLANT PHYSIOLOGY.

Part I.

Studies on Drought Resistance in Paddy.

(a) Root studies of paddy in puddled and dry ploughed conditions.

Preliminary observations are being made on the root growth and yield of paddy MTU 7 of this tract transplanted after puddling and immediately after letting in water in dry ploughed field. The roofs are to be excavated by the skeleton method of excavation as adopted in the East Malting Research Station by Rogers and Vyuyen (66) and Cochran (67).

(b) Determination of Minimum water requirements for four paddy strains.

1. Sembalai. — Grown under rainfed conditions purely as a dry crop in the Chingleput, North Arcot and South Arcot districts.
2. Pisini. — Grown under rainfed conditions purely as a dry crop in the Chingleput, North Arcot and South Arcot districts.
3. ADT. 22. — (Vadan) samba grown as a semidry paddy in the Central Districts.
4. GEB. 24. — Grown under wet conditions in several parts in the Province.

The minimum water requirements will be determined by varying the dosage of water applied at regular intervals, as to indicate the comparative growth under known moisture conditions and incidentally their comparative drought resistance and estimating water loss with control pots kept without plants under similar conditions and estimating evaporation with piche's evaportimeter.

(c) Determination of wilt and drought resistance.

Determination of wilt and drought resistance of a

few important paddy varieties in the Province in humidity and temperature controlled apparatus.

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PART II.

(1) Inducing drought resistance and submersion resistance

By treatment of seed in four of the following important cultivated strains:-

1. MTU. 12 (Pedda Atragadda) with GEB 24 (Kichili Samba) with CO. 17.
2. ADT. 22.

(2) Pre-treatment of seeds:- Will consist in subjecting embryouduring germination to:-

(1) Hot air and cold air treatment.
(2) Alternate hot air and cold air treatment.
(3) Anaerobiosis.
(4) Methane treatment in varying concentrations.
(5) Alternate soaking in water and drying.

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PART III.

Determination of Inundation Tolerance of anfew strains of paddy subjecting them to submersion in various stages of growth to different depthh for one and two weeks of submersion and studying their growth and physiological anatomy.

I. MTU 16. Badavakusuma. II. MTU. 1. Bontha Akkullu.

Treatment:- Height of water. 8 inches, 1 foot, 1 foot 3 inches, 2 feet.

Period of submersion. 7 days and 14 days.

Age for starting submersion -- 15 days after planting. 30 days and 45 days.

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PART IV.

Determination of salt Tolerance:- of paddy strains in typical black clay soil of known composition.

MTU. 12. Pedda Atragadda with S.r. 26B.
SLO. 12 Tella Garikasannavari with Tella thoka vadlu.

i. 0.05%. ii. 0.10%. iii. 0.15% iv. 0.20%. v. 0.25%.

The reactions in growth and the degree of tolerance will be assessed and the dry matter in the plants will also be analysed. Similar experiments will be repeated with Sodium carbonate. Sodium sulphate and Magnesium sulphate with seedlings of 30 days old.

Studies on the Physiology of paddy (Oryza Sativa)

as Influenced by Drought Submersion and Salinity:-

The aim of applied physiological research is to attempt to ascertain the best use to which the soil and prevailir climate, and other environment conditions can be put.

Although paddy is the major food crop in our Province, its yield is very low compared to several other countries in the East. The yield fluctuates very much and is mainly dependent on the season, rainfall, presance or absence of favourable moisture conditions.

Although the venues to improve the outturn are known much headway could not be made due to the lack of organic and inorganic manures in sufficient quantities, and the long time taken in breeding works to hybridise or acclamatise new varieties after amny years of intensive and large scale trials. The potentiality of each strain have yet to be scientifically evaluated.

The knowledge about the adaptations of several varieties of paddy to particular regions is mostly traditional based on the long experience of cultivators. As knowledge about the interaction of Plant metababolism with external factors increases, the selection of plants to suit particular environment will become a matter of less uncertainity than hitherto. Already after intensive breeding trials the several paddy breeding stations in our Province, have released several strains suited to certain localities and regions. Despite this, crop failures and low yield are a common feature when the conditions prove adverse.

Even in normal years, in the collair lake area in Kistna district, the back water regions of west coast and the rainfed tracts in the central districts where on fourth of the area of our Province is cropped under paddy, present problems of constant submersion salinity and drought that are detriment to its culture.

Maximum crop yield, as is well known is dependant on the presence of optimum conditions, which is influenced by several factors. The absence even any one of these factors tends to disturb the equilibrium resulting in variation in yield. At times even total crop failures are not uncommon when the conditions proved even slightly adverse. Such vagaries are mainly either due to the failure of the plant to tolerate or get adjusted to the new situation or toit inability to resist and overcome that condition.

The optimum intensity of each factor to be elucidated is made difficult by the interdependence of factors in their commulative effect on the Plant. Yet, investigations have pursued and persevered to evaluate their effect despite the limitations. In order to get a comprehensive knowledge concerning the physiological and morphological reactions of th plant to environment, it is proposed to study the behaviour growth and physiological anatomy of a few strains of paddy now cultivated over a large area in our Province. It will then be possible to assess their relative response to such int intensity of adverse conditions manifest in the day to day culture of paddy in our Province. Ultimately it is also intended to evolve a suitable technique to induce or increase the resistenceof paddy to extreme of conditions that are commonly found in the culture of paddy.

Review of Literature on the work done.

1. Drought Resistance and water requirement:-

Briggs

and Shantz (1913) were the pioneers to investigate and assess the water requirements of cultivated crops. A review of work relating to the same has been given by Kisselbach (1916) and Briggs and Shantaz (1931) Miller (1923). Henkal (1938) and Leather (1916) in India have investigated and determined the water requirements of several crop plants. Recently B.N. Singh (1935) and R.B. Sing (1935) have determined the water requirement of several cultivated crops of Bengal.

All these authors adopted the water consumption as the basis of water requirement in plants for the dry matter produced as determined in their experiments. Recently in Japan, Richiro Koketsa and Katsuo and Nagasava (1930) have evolved a power method wherein the volume of dry matter, got after powdering the dried plant has been adopted, as a measure of water requirement in preference to the weight of the dry matter.

On the basis of water requirement studies Alam (1939) reports that selections of crops made by Research Institute and Breeding Stations with a view to stand drought, require smaller amounts of water. He further adds that manuring of rice in any form, organic or inorganic, in addition to giving an increased yield, lowers the water requirement of rice. He has also indicated that large quantities of water usually seen in paddy fields is not an essential condition for the success of the crop and that once the plant gets established, no harm will result to the resultant crop B.N. Singh (1939) and P.K. Sen (1937) also subscribe to the above view as a result of more or less similar experiments carried out by them. Martin (1930) and Amodt. and Johnson (1936) give thorough discussions on the nature of drought and drought resistance of plants. After extensive trials with corn, sorghum and wheat, they consider three factors to be of major importance in inducing drought resistance and thereby minimising the water requirement, viz:-

1. Capacity of developing root system rapidly in the early stages of growth. 2. Ability to evade drought by quicker growth and maturity and 3. superior capacity to resist or endure drought without permanent injury. Similar observations on sorghum have been recorded by Vijayaraghavan (1938) at the Dry Farming Station, Hagari. Bayer, Tayler and Bartal (1937) have shown that wheat varieties known to resist drought under field conditions emerge with less severe injury under artificial test than others. Similar indications were furnished by Sohultz and Hayes (138) with legumes and pastures grasses and Hunter. Lande and Brusen (1936) working on maize. In fact Newton and Martin (1930) arranged a number of grasses in the order of their drought resistance as indicated by the above tests.

Several authors have viewed that osmotic pressure is a constant racial character, affording a measure of drought resistance, of plants. While agreeing to this view, Skazkin (1934) the eminent Russian worker on this subject doubts whether the methods that exist now really afford an indication of the osmotic pressure of plants and opines that methods of estimating osmotic pressure have yet to be perfected as to furnish a reliable index of drought resistance. Buchingers (1939) stresses on the importance of measuring osmotic pressure as it is a heritable character of great use to the plant breeder. Newton and Martin (1930) disagree with the view finding and osmotic pressure consistently failed to afford a reliable index of drought resistance. Stoddart (1935) believes that high osmotic pressure is a result of drought and not an adapatation to it.

Drought resistance has been correlated with the

the intensity of assimilation than with osmotic pressure by meayedew (1936) Novikov (1937) and Parlov (1932) relate drought resistance to water bound content and size of stomata in winter and early varieties of wheat, than to any other factor.

Inanov (1937) furnishes a test of diagnosing drought resistance in wheat varieties from their ability to germinate when subjected to heat and cold treatments. Basedon these studies, Henke and his associates (1938*) have elaborated a presowing technique for inducing drought resistance. Chinoy (1942) in India also found that by pre-showing treatment the water requirements of plants could be reduced. Kar (1944) in Bengal has alsorecorded earliness in ripening and drought resistance induced by such treatments. Parija (1943) working on paddy in Orissal Rice Research Scheme, also reports of significant differences in the yield and water requiremer of plants subjected to pre-sowing treatment than the untreated ones.

Very recently Pal (1945) working on wheat in the Imperial Agricultural Research Institute, Delhi, has shown that pre-sowing and hardening treatment [illegible] induces drought resistance. Drought resistant varieties are also reported by him to be alkali tolerant in seven varieties of wheat tried by him. Drought resistant varieties are also reported to withstand disease and pest, incidenc better and others.

II. Submersion and tolerance of paddy to excessive wate

Mostly paddy is cultivated under swampy conditions and in our Province roughtly over two thirds of the area under paddy is cropped under wet conditions. Large quantities of water are usually seen in the paddy fields and reliable data on the optimum water requirements of even important cultivated commercial, varieties are still lacking. It is not known whether such large quantities of water are an essential requisite for the optimum growth of paddy an intake or for maintaining the humidity. Alam (1939) as already referred before, views that large quantities of water are not essential conditions for the success of crop and that once the plant gets established and the soil remains moist no harm will result to the yield. Experiments are yet to be conducted in confirm these views.

During the monsoons, in deltaic areas and in projects under great irrigation systems, excess of water and lack of drainage are a problem in the culture of paddy in our Province. A appreciable loss of crop and reduction in yield have occurred due to the submersion of entire fields during the monsoonic periods. The degree of tolerance to such conditions has not been assessed by any reliable experiments so far, since field experiments on submersion can never be successfully conducted due to the presence of such vitiating factors as percolation, seepage, etc.

An experiment is proposed to be conducted to test, the tolerance of 3 varieties of paddy, in cement tubs, keeping as far as possible the conditions that occur in fields. The degree of tolerance, the nature of response from the crop and the physiological anatomy are proposed to be studied.

The paddy plant under swamp conditions presumably experiences deficiency of oxygen and light. Paddy is the outstanding crop among cereals to thrive excellenty under such conditions. Cannon (1935) concluded after extensive studies

that low oxygen tension and low sensitivity of roots as responsible for the development of paddy under wet conditions. Harrison and Aiyer (1915-16) discovered that large amounts of methane and algne present in swamp paddy soils as sources of moleccular oxygen for the root respiration of submerged plant. Bergamann (1920) suggested that the presence of aerenchyma as one of the factors responsible for the tolerance of paddy under submerged conditions.

Edwards (1933) reported that paddy exceptionally germinates in the absence of oxygen and opined that seedling rice possessed a type of respiratory metabolism that produces non-toxic intermediary products completely prevented on a greater tolerance to toxic products than other plants. Sethi (1930) as a result of pot and field experiments identified two types of roots in rice one resembling the structure of wheat and the other containing air spaces of acquaticroots. Vlamis and Davis (1934) found rice consistantly excelling under wet conditions particularly the root system when compared with barley and wheat, which failed to thrive He also found the weight of ptassium in drained roots twice that of the submerged roots. Methane treatment is reported by him to increase thefresh weight of roots in rice by over seventy per cent compared with the untreated ones.

Many deep water varieties of Bengal, thrive exceptionally better than others under submerged conditions. Pariya (1938-40) found that these flood resistant varieties possess a gridle of Bolerenchyamatous tissue around the certical lacuna similar to those in aquatic grasses. Ideko (1937) opined that lowland varieties in India are more highly developed than upland dry paddy varieties which retained several primitive characters.

Very recently Pillay and Parija (1944) subjected the activiated germ of paddy to anaerobiosis and Low temperature. After germination the seedlings were subjected to submersion for 15,20 and 25 days after 60 days growth. They found that the treated seeds were superior to non-treated ones in survival after submersion in flowering and yield. The experiments are still being continued and possibilities of inducing food, resistance by pre-sowing treatment have been indicated.

In our Province trials at the Paddy Breeding Stations have shown that MTU 16, Badava Kusuma and PTB 16 Kavinginpoothala as two outstanding flood resistant varieties. But information on the degree of their tolerance the age and time upto which they can withstand and the physiological reactions likely to occur are yet to be assessed.

Salinity and salt tolerance of paddy.

The amount of salts which crop plants can tolerate in sand cultures under normal climatic conditions has been reported by many authors. A review of the same has been given by Eaton (1942) and Hayward and Long (1942).

In order to obtain definite information on the salt resistance of plants, several regional stations and laboratories have been started in America and a series of experiments are underway to determine the salt tolerance of crop plants to the salts commonly found in irrigation waters and soils and to what extent climatic factors modified these effects. Hilgard (1937) has stated that the toxic limit of sodium chloride for any crop was 0.25 per cent concentration, where as Piser (1945) stated that concentration of sodium chloride over 0.1 per cent as

unfavourable and toxie to the growth of plants. Practically very little information is available about the salt tolerance of even 'commercial strains of paddy now cultivated over a very large area in our Province'. With pot culture experiments on Akkullu (MTU) 1. and S.R. 26-B Sanyasiraju (1945) has roughly indicated that salt tolerance ranges from 0.125 to 0.25 per cent and higher limits as toxic.

Effect of salinity on crop plants:- High Concentration of Sodium Chloride in crop plants was found by Eaton (1942) to reduce height and diameter of stems, reduce to cambial activity, thicker xylem vessals, inhibit flower development and fruit set. Similar observators have been recorded by Hayward and Long (1942) and Robbine W. Roi (1937) Espine (1931) Peralta (1927) etc Harter (1908) found many crop plants grown in the soil containing 0.7, 1.0, 1.4 per cent of sodium chloride developing thick cuticle with waxy bloom. Similar retardation in growth have been recorded by many investigators such as Hendry (1918) Miller (1938) Germin (1937) Hart and Tettingham (1915) etc. Harrison and King (1938) have shown that the age of the plant is an important factor determining the degree of toxicity of sodium chloride.

Stunted growth and reduced leaf area were noticed by Peralta (1927) with increasing dozes of sodium chloride added to complete nutrient solution in race. The toxicity of very low and high phrion concentrations on rice have been recorded by Mitre and Phukan (1929). Reduced dry matter and yield were found by Dastar and W. John (1939) in rice, when grown in solutions with P.H. concentration over 7 and below 6. Long (1943) has shown that above these concentrations the salts accumulate near the absorbing emmbrane of roots and act deleteriously indirectly on the protoplasm Dennett (1936) and Espins (1931) have already recorded Symptoms in confirmity with the above observations on rice. Failur of ragi and onion and other agricultural crop have been recorded at Siruguppa (1942-43) when the concentrations of salt exceeded 0.2 per cent in the soil.

Decree of tolerance:-The capacity of plants to endure alkalisalts according to Hibbard (1921) vary with the physical character of soil, kind and amount of water, moisture, climate, etc. .Despite these factors, Brazeale (1936) maintains that salt tolerance in plants is largely a matter of adaptation and development of physiological differences, such as development of mechanism for lowering the rate of transpiration thickening of culticle, etc. (Dore 1938) has in foot recorded higher saberin content in the roots of salt tolerant plants.

Osterhout (1907) working on marine plants recorded that salt when it functions alone is poisonous and that a mixture as in sea water gives a physilogically balances solution which the plant is capable of using. Hence he advocated the addition of a suitable correctives, to restore and maintain the physiological balance of minerals. In some cases Killiam (1931) noticed greater concentration of salt in plants in the same soil and found great variation in the different speciesin relation to the salt accumulated in the same soil. Montfort (1929) opined that resistance of plants to high salt content varies at different stages of development of plant with different concentrations of salt. Kearney (1936) accordingly classified salinity into several grades depending on the salt concentration and the tolerence of plants.

Determination of salt tolerance:- Headley, Curtis and Soofield (1914) reviewed that the limit of tolerance of crops can be best determined by the amount of salt recovered from the

soil water than by the usual method adding a known quantity of salt or growing in cultures.

R.H. Dastur and R.F. Cooper (1938) suggest that the salt requirement can be determined by changes in theosmatic and suction pressure of roots and leaves. Reliable methods for determining osmotic and suction pressure are yet to be devised. At present, most of the investigators have their experiments on the study of crop performance and their reaction on culture solutions to which known concentration of salts have been added.

Salt tolerance upto a certain limit is an adaptation in the developmental mechanism of the plant varying with different varieties and species. With trials at the paddy Breeding Stations C.R. Srinivasan (Madras Agricultural Journal Report (1943-44) has indicated that Tella Thoka Vadlu and S.R. 26-B. of Orissa as two notable salt resistant varieties. The necessity for conduct of reliable trials to pick up inherently resistant plants both for breeding work for hybridisation and resisting salinity saline tracts have been indicated by C.R. Srinivasan and T.D K. Balaji Rao. In the same report they further observe 'that non of the important commercial varieties in the Province are known to possess any ability to tolerate adverse soil conditions to any marked degree The need, therefore, to secure data on the salt tolerance of at least of a few commercial strains to known degrees of salinity occurring in the varioustracts is obvious.

(Sd) x x x
Plant Physiologist.

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GOVERNMENT OF MADRAS.
Abstract

Public Services - Provincial - Madras Agricultural Service - Temporary post of Cytogeneticist and Plant Physiologist, Bapatla - Review of work.

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DEVELOPMENT DEPARTMENT.

G.O. Ms. No. 4033. Dated the 2nd September 1948.
Read:-

G.O. Ms. No. 1003, Development, dated 1.3.1948.
Letter from the Director of Agriculture, No. X-1-450/48 dated 6.5.1948.
Letter from the Director of Agriculture, No. X-1-450/48 dated 29.5.1948.

Order:-

Recorded with the following remarks.

2. The Director of Agriculture is requested to direct the Plant Physiologists to concentrate attention on 'Vernalisation of paddy" as suggested in his letter No. D.Dis. D.140/47 dated 22.7.1947. He is also requested to place a copy of the report of the work done by the Cytogeneticists and the Plant Physiologists before the Research Council, Coimbatore for their scrutiny and remarks, if any.

(By Order of His Excellency the Governor).

x x x x

To

The Director of Agriculture, Madras.

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k.y.s. 12.8. /True copy/ Superintendent, Madras Record Office.